Crystal Ageing Studies at USC

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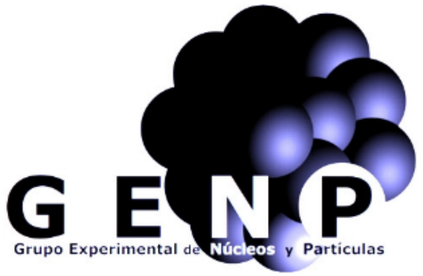


Experimental Configuration

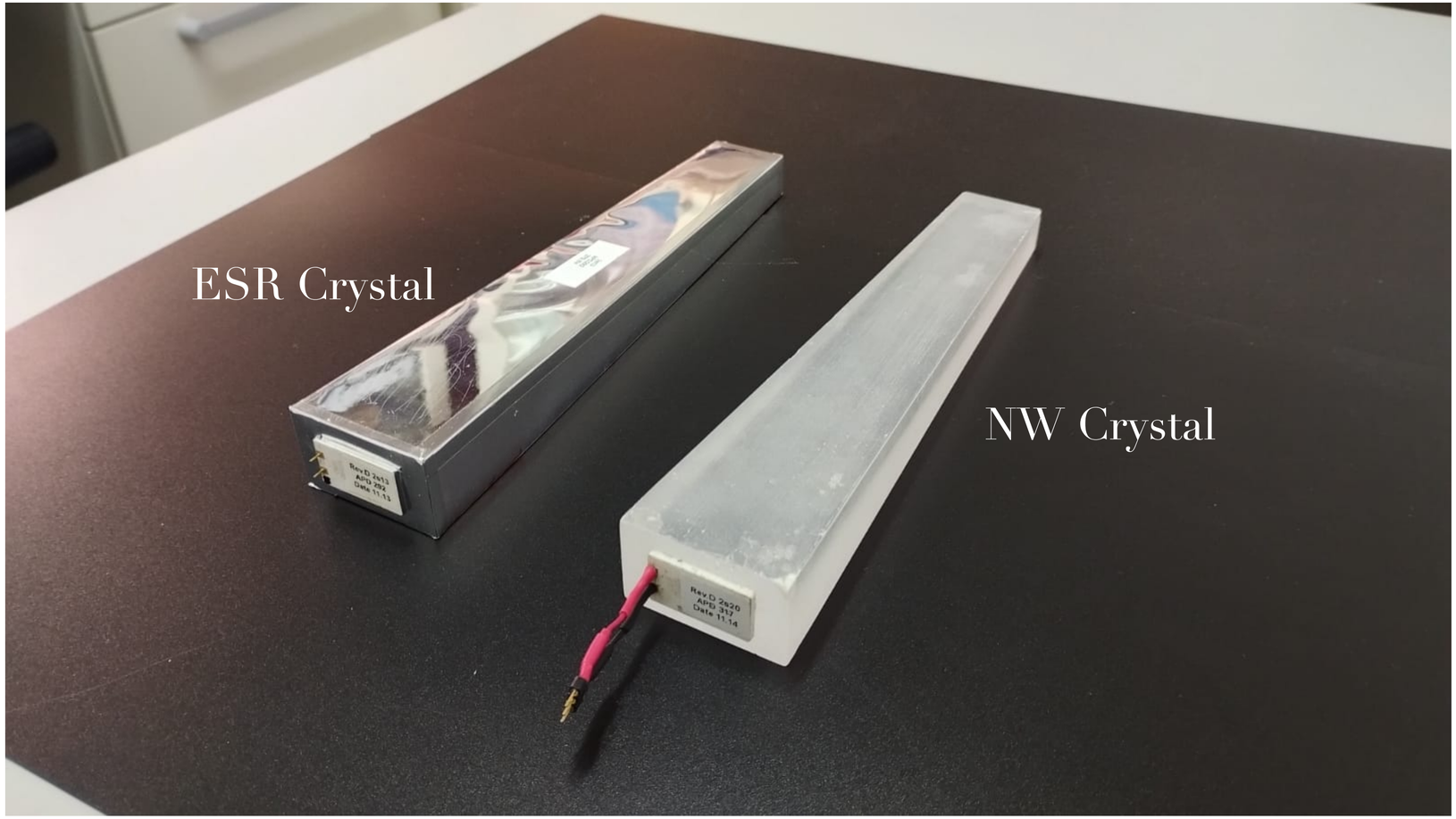
- Two detection units placed in three **different locations,** with variable conditions (temperature and humidity).

- **106 Measurements** (~ Every two weeks) : From 18/02/2020 to 12/12/2022.

- 11 measurements for each crystal: One **frontal** + 10 **LONU's** = 2332 spectra.

- ^{137}Cs - ^{60}Co (662 keV, 1.17 MeV, 1.33 MeV) source.

- APD -> Mesytec MPRB-32 -> Multichannel



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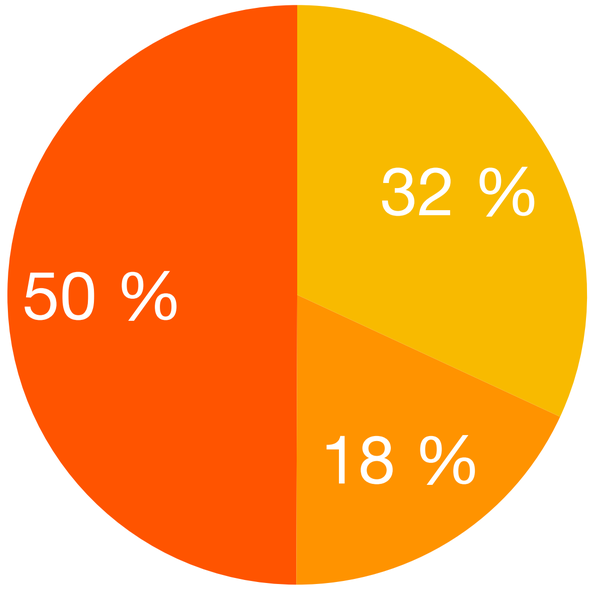
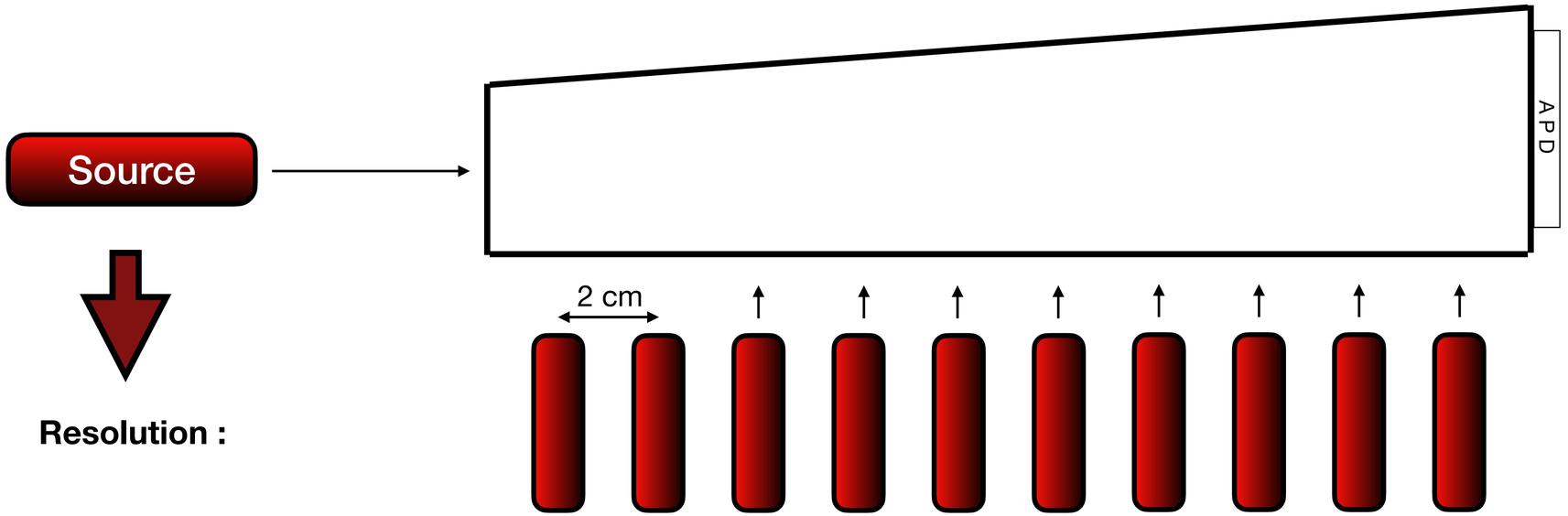
- ^{137}Cs - ^{60}Co (662 keV, 1.17 MeV, 1.33 MeV) collimated source.

- APD -> Mesytec MPRB-32 -> ORTEC Multichannel

- Laboratory (LOC 1). Air circulation, people working inside.
- Basement (LOC 2). Cold and very humid, but stable.
- Entrance (LOC 3). Only a few meters away from the street.



Temporal Distribution



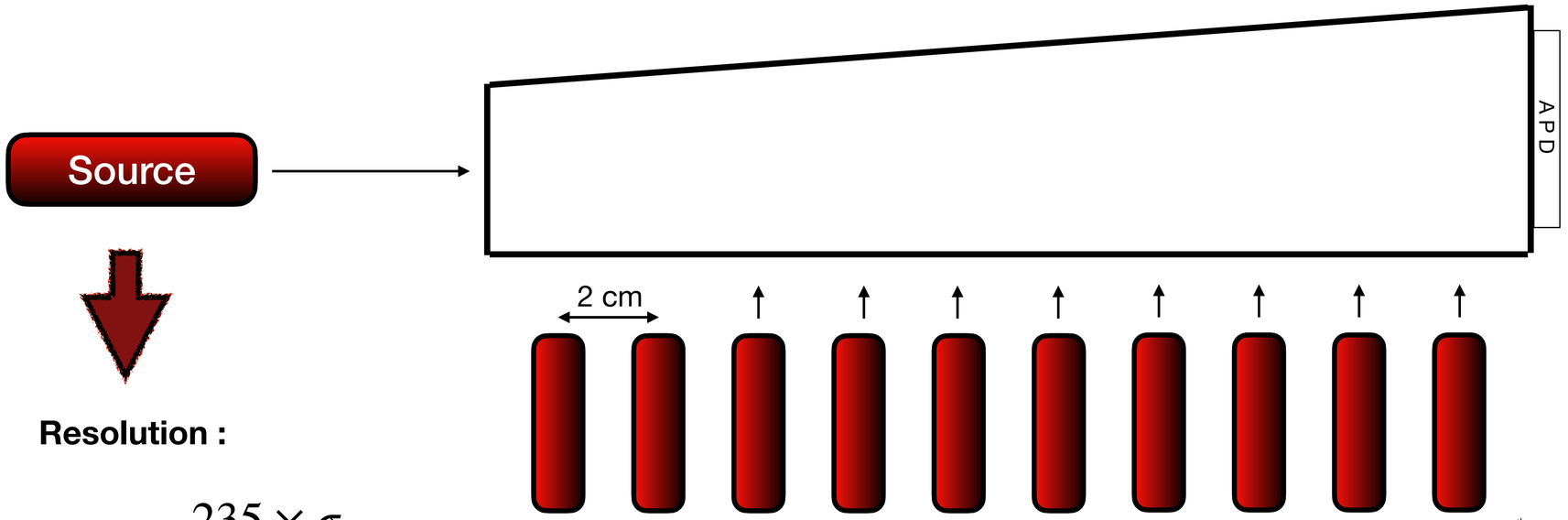
Resolution :

$$R(FWHM) = \frac{2\sqrt{2\log 2)} \times \sigma}{\mu}$$

$$R(E) = \frac{a}{\sqrt{E}} + \frac{b}{E} + c$$

LONU :

$$LONU = 100 \times \frac{\mu_{max} - \mu_{min}}{\frac{1}{N}\sum \mu_i}$$



Resolution :

$$R(FWHM) = \frac{235 \times \sigma}{\mu}$$

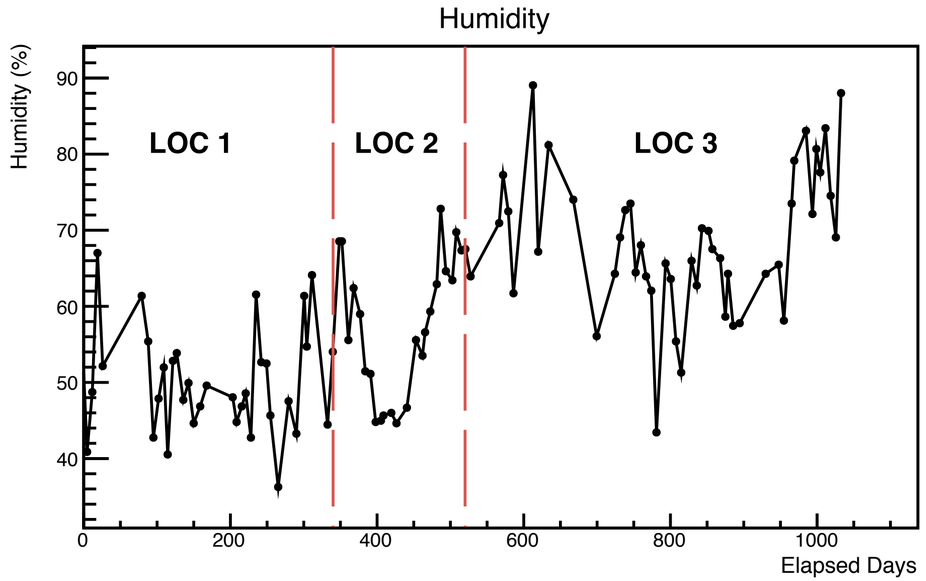
$$R(E) = \frac{a}{\sqrt{E}} + \frac{b}{E} + c$$

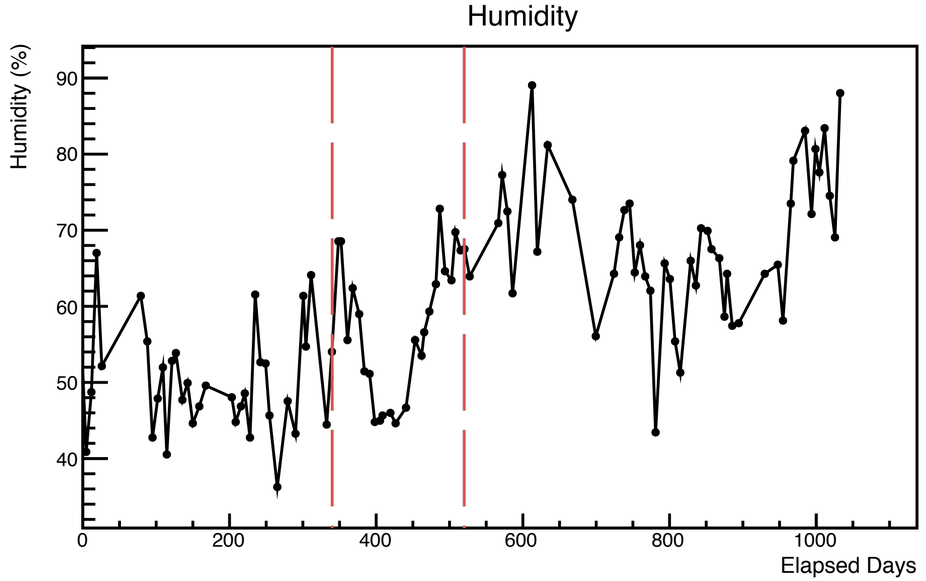
Temperature, humidity, pressure and mass are also measured and registered.

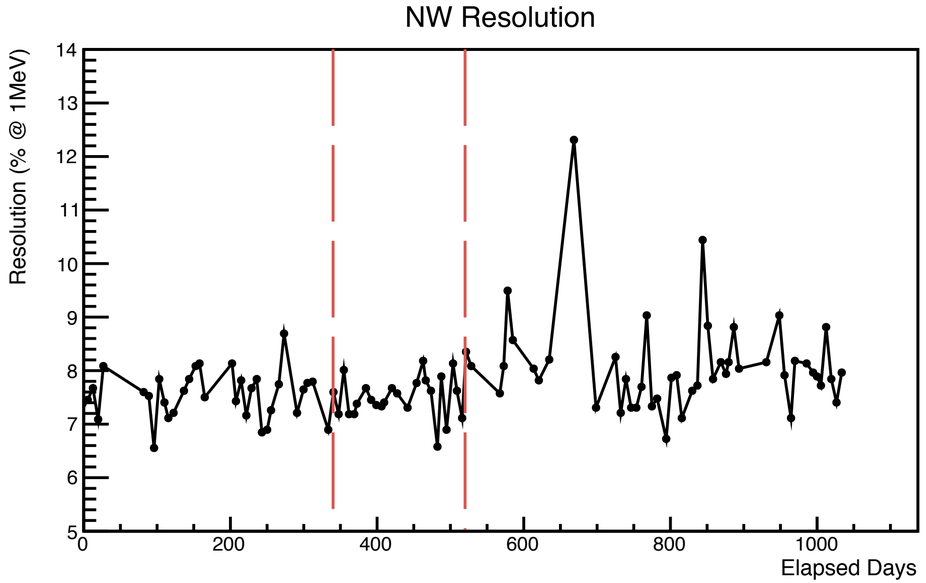
LONU :

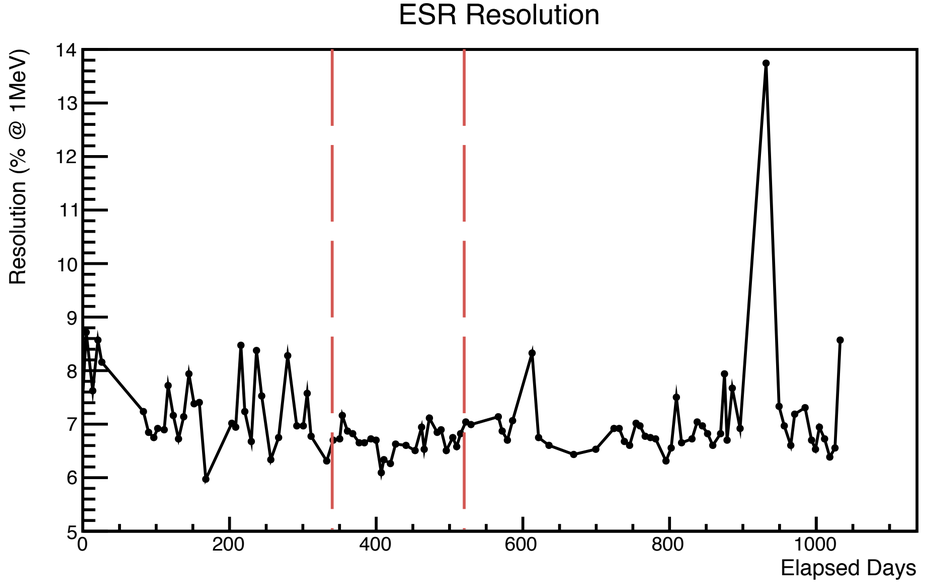
$$LONU = 100 \times \frac{\mu_{max} - \mu_{min}}{\frac{1}{N}\sum \mu_i}$$

Temporal Evolution

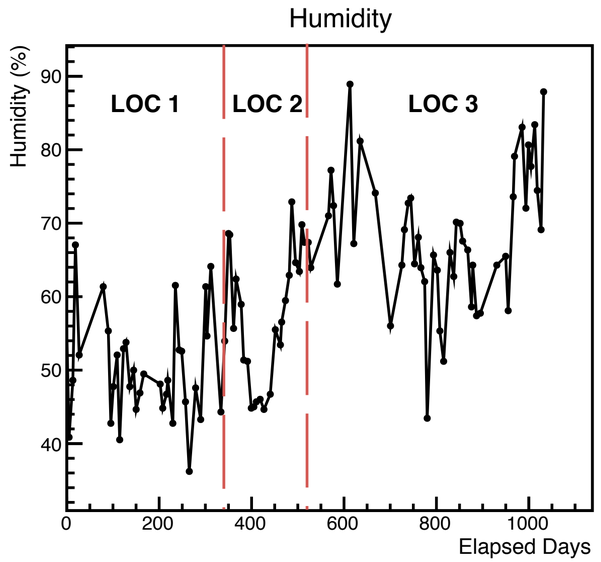


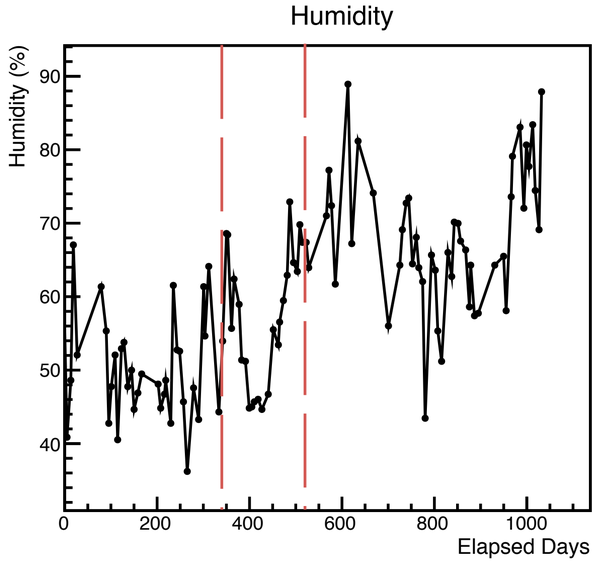


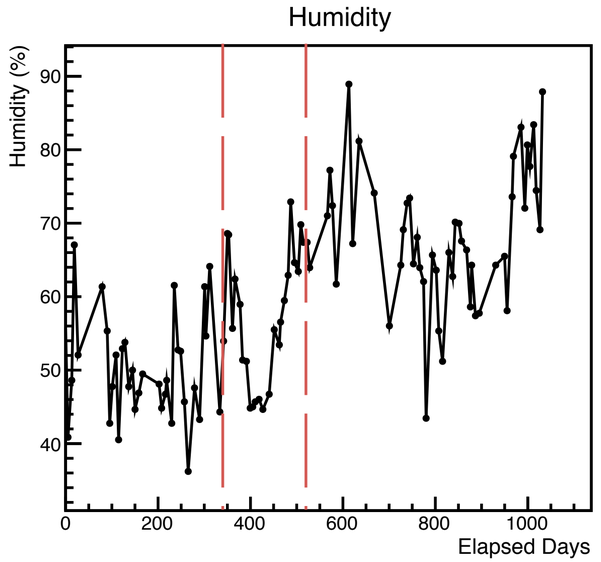


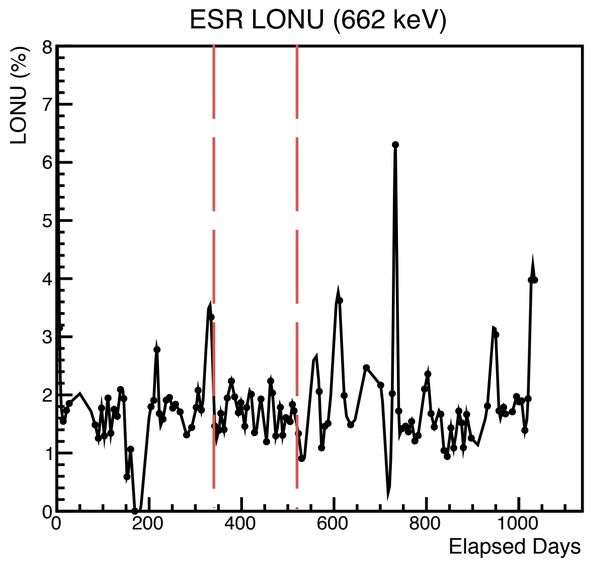


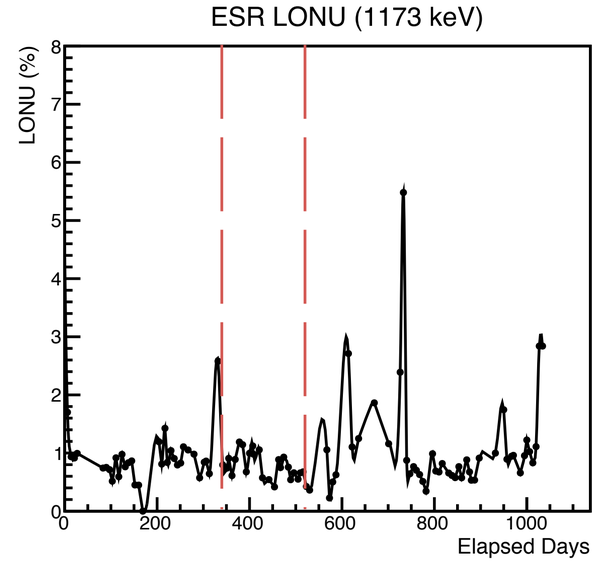
Temporal Evolution

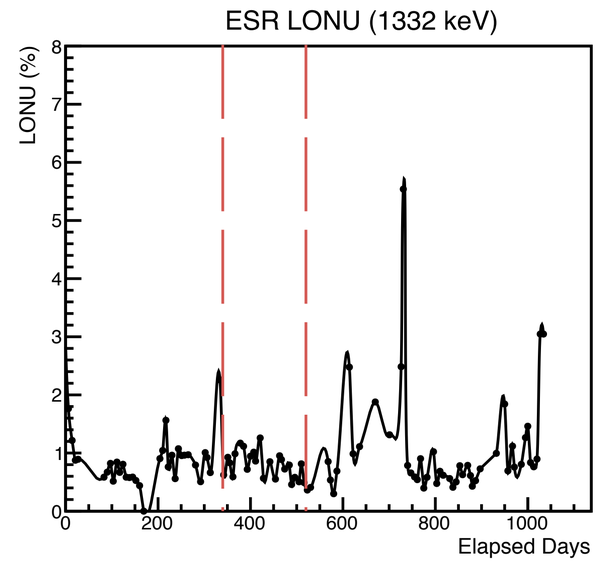












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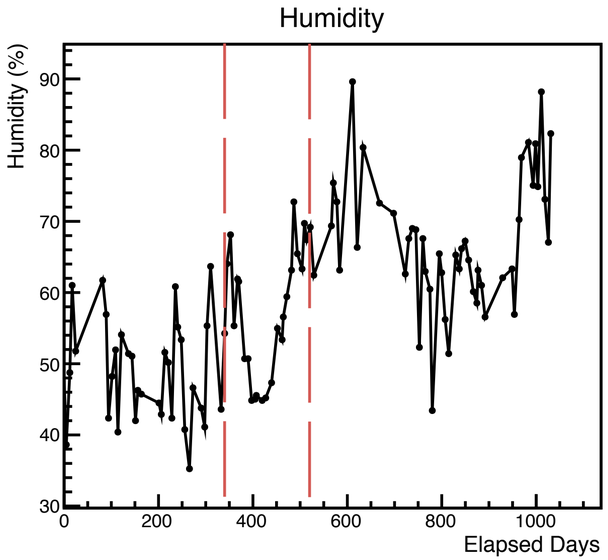
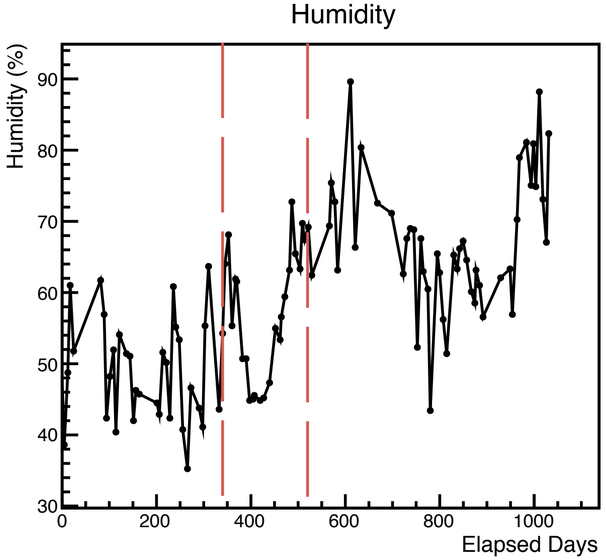
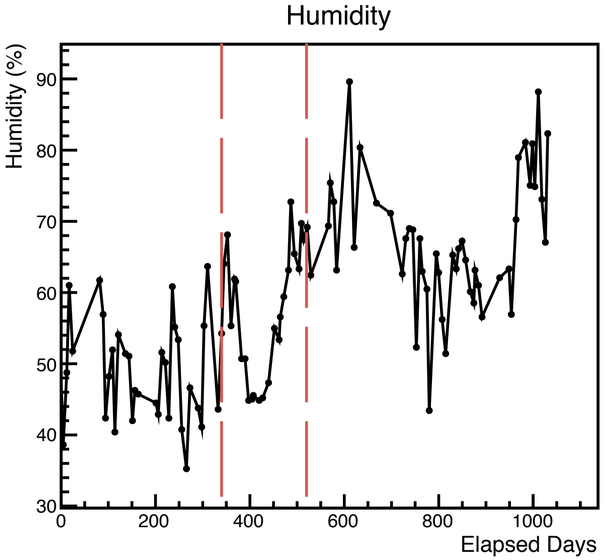
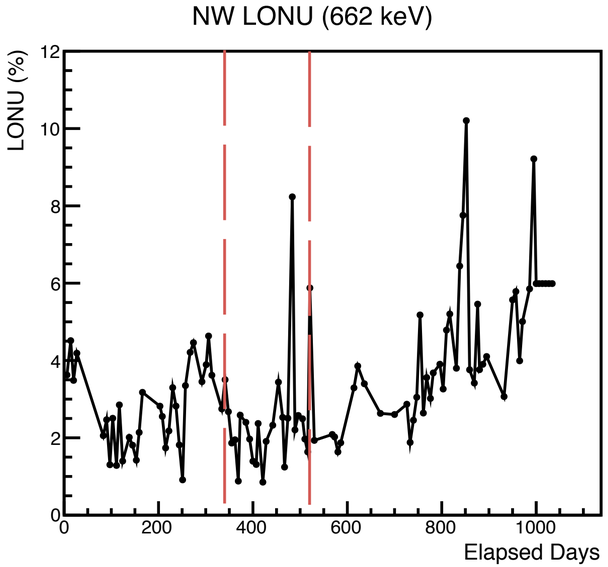
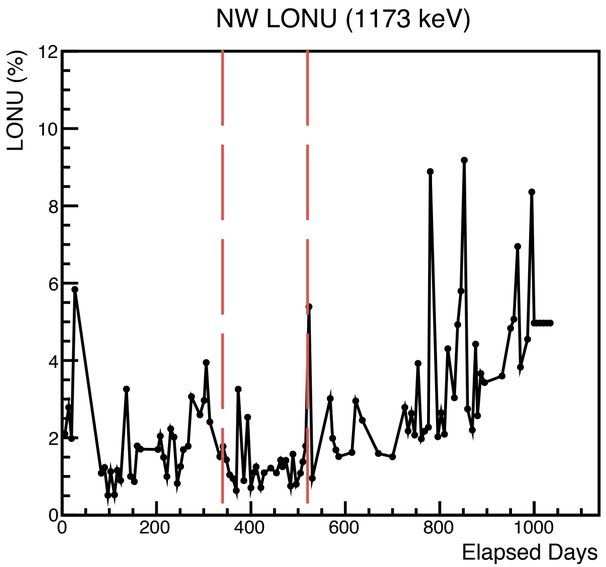
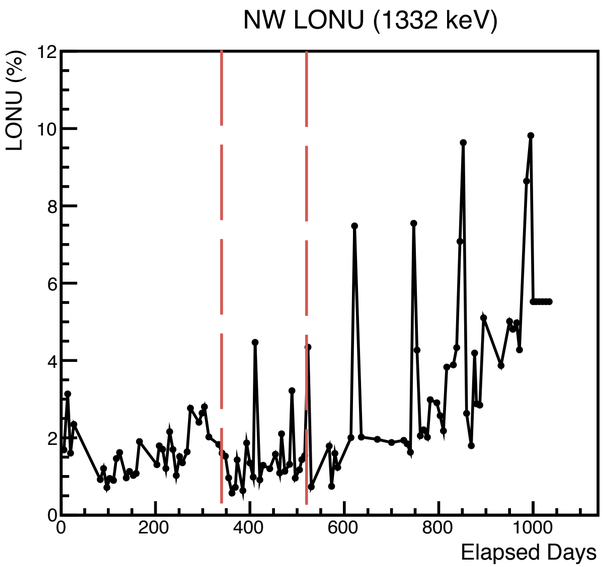


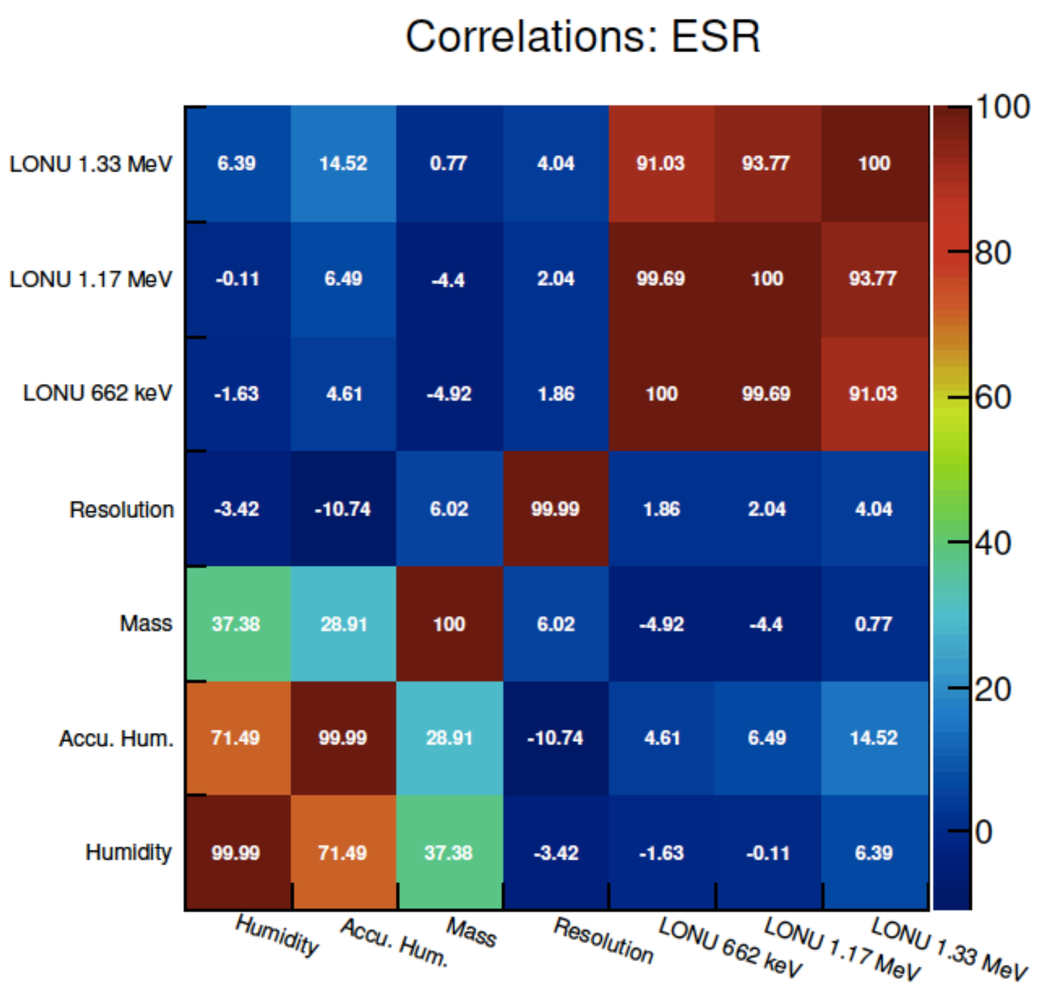


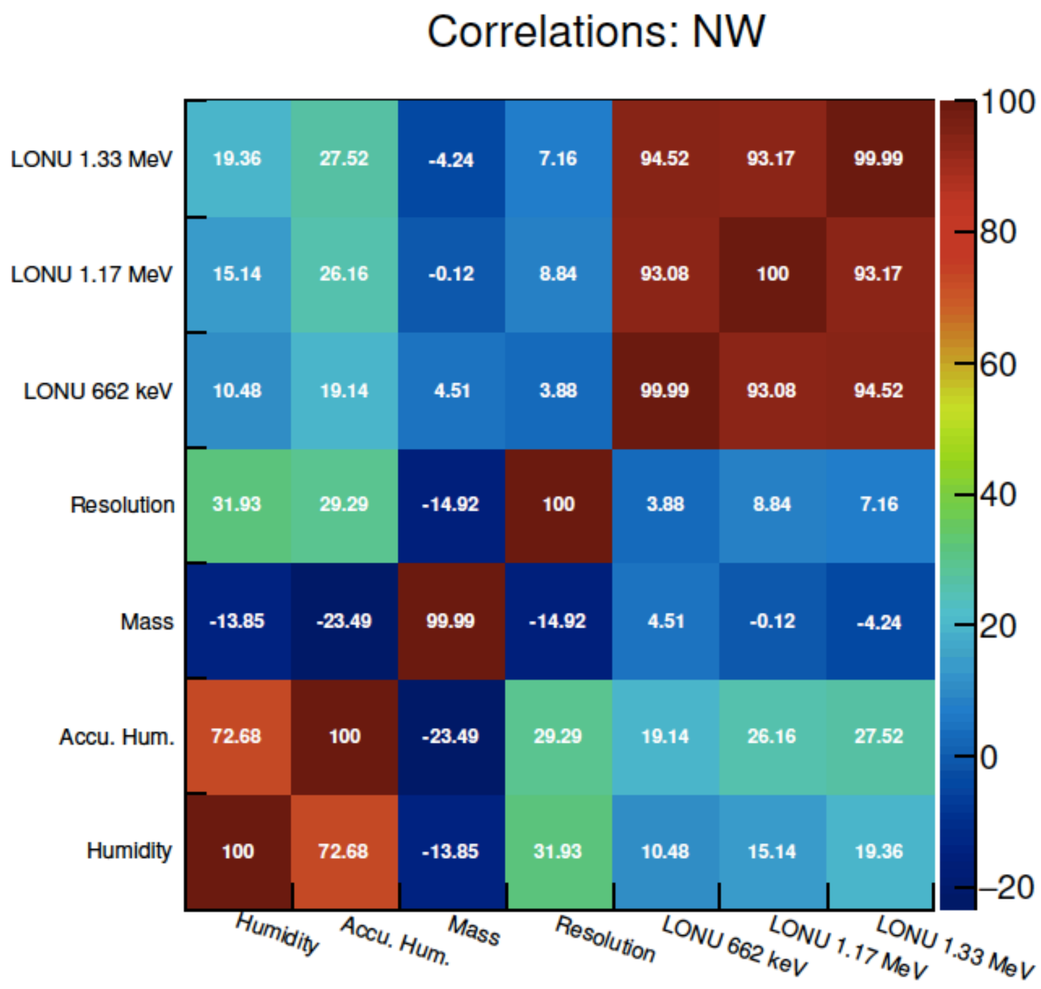




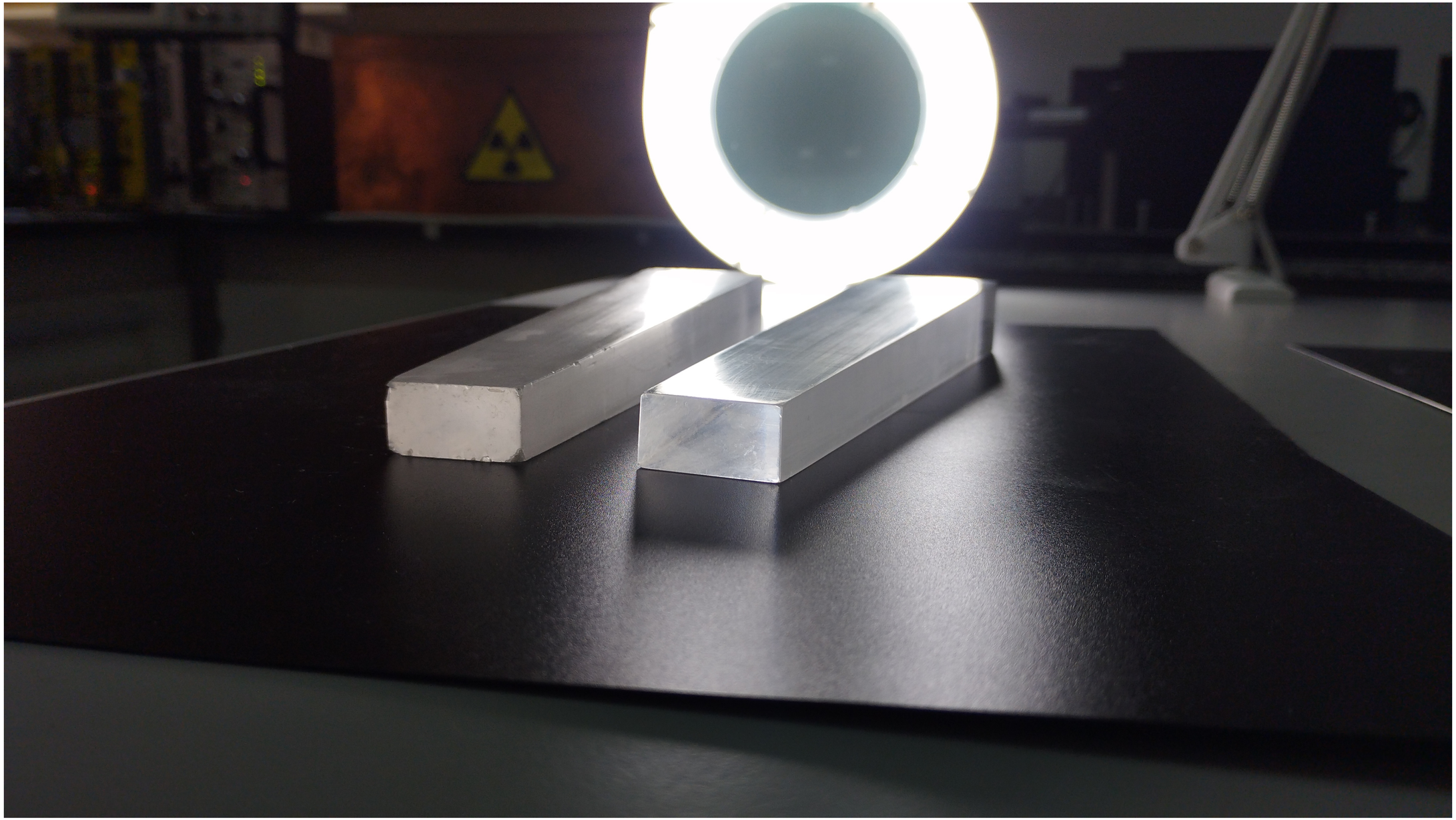





Correlations: ESR
LONU 1.33 MeV
LONU 1.17 MeV
LONU 662 keV
Resolution
Mass
Accu. Hum.
Humidity
6.39 14.52 0.77 4.04 91.03 93.77 100
-0.11 6.49 -4.4 2.04 99.69 100 93.77
-1.63 4.61 -4.92 1.86 100 99.69 91.03
-3.42 -10.74 6.02 99.99 1.86 2.04 4.04
37.38 28.91 100 6.02 -4.92 -4.4 0.77
71.49 99.99 28.91 -10.74 4.61 6.49 14.52
99.99 71.49 37.38 -3.42 -1.63 -0.11 6.39
Humidity
Accu. Hum.
Mass
Resolution
LONU 662 keV
LONU 1.17 MeV
LONU 1.33 MeV
100
80
60
40
20
0


Correlations: NW
LONU 1.33 MeV
LONU 1.17 MeV
LONU 662 keV
Resolution
Mass
Accu. Hum.
Humidity
19.36 27.52 -4.24 7.16 94.52 93.17 99.99
15.14 26.16 -0.12 8.84 93.08 100 93.17
10.48 19.14 4.51 3.88 99.99 93.08 94.52
31.93 29.29 -14.92 100 3.88 8.84 7.16
-13.85 -23.49 99.99 -14.92 4.51 -0.12 -4.24
72.68 100 -23.49 29.29 19.14 26.16 27.52
100 72.68 -13.85 31.93 10.48 15.14 19.36
Humidity
Accu. Hum.
Mass
Resolution
LONU 662 keV
LONU 1.17 MeV
LONU 1.33 MeV
100
80
60
40
20
0
-20

Crystal Defects



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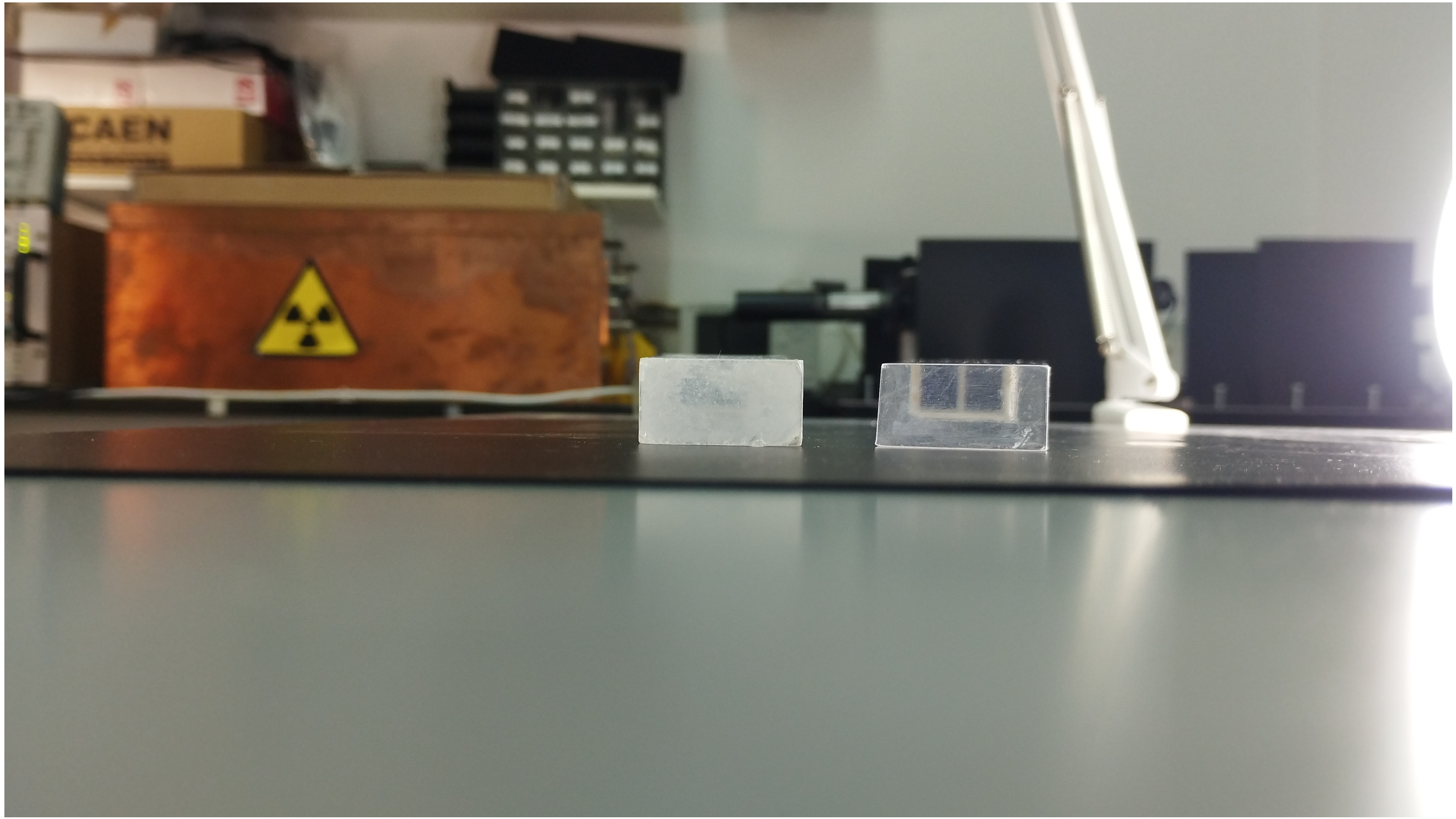

Conclusions

- ESR wrapping acts also as a perfect isolation from humidity, even if the crystals are not preserved in a controlled atmosphere.

- Flexible in terms of frontal resolution. The crystal can be “recovered” after an exposure to bad conditions?

- The overall evolution of the unfolded crystal LONU shows that despite this quantity increasing along time resolution is not affected in a drastic way.